

# Change in Organizational Structure Influences Perceived Leadership in a Dutch Radiotherapy Center

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**Purpose:** Healthcare organizations face challenges in balancing efficiency and innovation, known as ambidexterity. Leadership plays an important role, with transformational leadership driving innovation and transactional leadership supporting efficiency. The dominant leadership framework is the Full-Range Leadership Theory (FRLT), which identifies three leadership behaviors: transformational, transactional, and passive avoidant. Organizational structures, following Mintzberg, Pugh and Galbraith, including span of control (SoC), unit grouping, and lateral linkages, significantly influence leadership dynamics. This study examines the impact of structural changes on perceived leadership styles in a Dutch radiotherapy center (RTc) following the implementation of proton therapy, a radical innovation.

**Patients and Methods:** A mixed-method approach combined leadership surveys, with data collected at three time points, before and after structural changes in 2022. The multifactor leadership questionnaire (MLQ) was distributed among the employees in November 2021, March 2022, and March 2023. Three interventions were introduced: (1) appointing dedicated team leaders (TLs) to improve information flow and reduce management SoC; (2) integrating a Patient Care (PC) manager into the advisory board to facilitate direct communication within the governance structure, including other hierarchical layers; and (3) adding a proton therapy manager as a liaison to improve coordination. Leadership perceptions were measured using the Multifactor Leadership Questionnaire (MLQ) at three time points (T1, T2, T3). The Independent-Samples Mann–Whitney *U*-Test ( $p < 0.05$ ), was used to compare T1, T2, and T3, managers' self-ratings with employee ratings, and scores between photon and proton treatment employees.

**Results:** Transformational leadership significantly increased across all groups, with PC scores rising from 2.3 at T1/T2 to 2.5 at T3, and MT-PC scores from 1.8 at T1 to 2.4 at T3. Passive avoidant leadership significantly decreased (eg, MT-PC: 1.6 at T1 to 1.0 at T3). Transactional leadership showed less pronounced and non-significant changes. Photon therapy staff experienced earlier improvements in leadership perceptions, while proton therapy staff showed delayed but stronger shifts by T3.

**Conclusion:** In this study, structural changes positively influenced leadership perceptions, supporting ambidexterity. Significant increases in transformational leadership and decreases in passive avoidant leadership align leadership styles with the dual demands of innovation and operational efficiency, demonstrating the importance of organizational design in healthcare leadership. Our findings show that healthcare management could use organizational structure changes to promote transformational leadership.

**Keywords:** leadership, healthcare, radiotherapy, ambidexterity

## Introduction

Healthcare leaders face significant challenges, including shortage of personnel and the need for sustained quality improvement while ensuring equitable and affordable access. These challenges are expected to intensify, requiring proactive strategy evaluation and action.<sup>1–4</sup> Shortage of personnel is increasing since workers leave due to uncompetitive wages and working conditions.<sup>5</sup> The shortage of staff is particularly acute among radiotherapy technicians (RTTs), who are essential for the accurate and efficient delivery of cancer treatments. This shortage places added pressure on retaining

staff, leading to increased workloads, potential burnout, and compromised patient care.<sup>6–8</sup> Since increasing quality and equitable and affordable access for every patient is required as well, management often chooses an organizational strategy which enables the organization to remain efficient, while being innovative at the same time.<sup>9–11</sup> This simultaneous pursuit of exploitation (efficiency) to control costs and exploration (innovation) to increase quality, access and affordability is also referred to in the literature as ambidexterity. Exploitation involves maximizing efficiency, refining existing processes, and leveraging current capabilities, while exploration involves seeking out new opportunities, innovation, and adaptation to change. An ambidextrous organization can effectively manage both aspects simultaneously, allowing it to adapt to changing environments while also exploiting its current strengths for sustainable success.<sup>12–17</sup> Ambidextrous organizations separate exploratory units from their traditional operations, allowing these new units to develop distinct processes, structures, and cultures. However, they maintain close coordination between these innovative units and the existing organization at the senior management level. This top-level integration ensures that the new units have access to established resources such as capital, talent, and customers, while protecting them from the routine constraints of “business as usual”. At the same time, existing units are shielded from the distractions of innovation efforts, enabling them to concentrate on refining operations, enhancing products, and serving customers effectively.<sup>17</sup> Leadership plays a crucial role in addressing the challenges, and in the context of ambidexterity, it involves maximizing efficiency, refining existing processes, and leveraging current capabilities and at the same time seeking out new opportunities, innovation, and adaptation to change, also called ambidextrous leadership.<sup>12–17</sup> Leaders must promote creativity and adaptability while ensuring operational effectiveness. This dual approach can be implemented through structural ambidexterity (separating innovative and routine tasks) or contextual ambidexterity, where teams perform innovative and routine tasks in their day-to-day roles.<sup>16,18</sup> Leadership concepts have been studied and defined in a wide variety of ways.<sup>19</sup> Common components are: a) leadership is a process b) whereby an individual influences a group of individuals c) to achieve a goal. Framing leadership as a process implies that a leader affects and is affected by followers and emphasizes that leadership is not a linear, one-way event but an interactive event.<sup>19</sup> Leadership also interacts with organizational structure as successful leaders can adapt their behavior and leadership style to meet the needs of each unique situation and organizational structure.<sup>20</sup> At the same time, the organizational structure is a major determinant of leadership styles.<sup>21,22</sup> Organizational structure, defined by Mintzberg (1980), as the division of labor and coordination mechanisms, shapes leadership styles while leaders adapt to structural needs.<sup>23–25</sup>

There is limited evidence about leadership styles that work well in an ambidextrous organization<sup>13,14</sup> and which characteristics of the organizational structure impact ambidexterity.

## Leadership Fostering Ambidexterity

The most dominant approach to leadership is the “full-range leadership theory” (FRLT),<sup>26–28</sup> which distinguishes three types of leadership behavior, namely transformational, transactional, and non-transactional laissez-faire leadership. Transformational leaders proactively inspire followers to pursue collective goals and achieve extraordinary results. Transactional leadership focuses on fulfilling contractual obligations through goal setting and performance. Non-transactional laissez-faire leadership, the most passive and ineffective form, involves leaders avoiding decisions, relinquishing responsibility, and neglecting their authority, actively choosing inaction.<sup>26</sup> Some authors suggest that transformational leadership may encourage exploration,<sup>13,29–36</sup> whilst transactional leadership may be more conducive to promoting exploitation.<sup>30,34</sup> Transformational leaders may support ambidexterity best, by disrupting the status quo, infusing task significance, rallying followers to tackle challenges, and fostering qualities essential for ambidextrous organizations.<sup>37,38</sup>

## Design Principles of the Organizational Structure Relevant for Ambidexterity

Organizational structure defines the formal division of labor (assigning tasks horizontally or vertically), the grouping of tasks (clustering into jobs, units, and departments), and the coordination of activities to ensure alignment and effective collaboration.

Key design principles mentioned in literature include job specialization, behavior formalization, standardization, unit grouping and span of control (SoC).<sup>25,39</sup> Additionally, lateral linkage principles such as planning and control systems,

and liaison devices play a vital role.<sup>25,39</sup> Galbraith (1973)<sup>40</sup> demonstrated that liaison devices range in complexity from liaison functions and task forces to integrating managers and fully developed matrix structures. These structures emphasize the importance of shared decision-making, challenging the traditional principle of unity of command. Decision-making rules to regulate decentralization, often referred to as decentralization, can be divided into vertical and horizontal decentralization.<sup>25,39</sup>

Achieving ambidexterity, balancing innovation and efficiency, poses a structural challenge as the design elements supporting exploration differ from those favoring exploitation.<sup>14</sup> This often necessitates hybrid or dual-structured organizations.<sup>12–15,30,41–43</sup> Successful organizations balance exploitation and exploration by separating exploratory units from traditional ones, enabling distinct processes, structures, and cultures. Simultaneously, they maintain strong connections through liaison roles and decentralized management at the senior level.<sup>17,44</sup> Below, we shortly address the design elements SoC, unit grouping, and lateral linkages, and their relation with perceived leadership in an ambidextrous context. In innovating, exploring contexts, unpredictable workflows, complex tasks and high interdependence require smaller SoC, to enable close coordination and communication.<sup>44,45</sup> In addition, teams (unit grouping) must be empowered for mutual adjustment, emphasizing autonomy, collaboration, and adaptability. Managers in such settings adopt transformational roles of facilitation and inspiration rather than direct supervision, with smaller units aiding coordination (lateral linkages).<sup>46</sup> In contrast, standardized, exploitative tasks allow for wider SoC due to lower supervision needs.<sup>44,45</sup>

## Case Setting and Research Objective

In previous research, we reported on the implementation of proton therapy in a large academic Dutch Radiotherapy Center (RTc).<sup>47</sup> This center is a learning and innovative organization with an extensive quality management system which is as much as possible embedded in the operational structure itself. The center has many characteristics that require it to be ambidextrous. The RTc treats approximately 4000 patients yearly with conventional radiotherapy (photon therapy) and 300 patients with proton therapy which is aimed to reduce the dose to normal tissues.<sup>48</sup> Proton therapy matches the characteristics of a radical innovation,<sup>47</sup> namely new engineering principles, new scientific evidence methods, potential new application(s), new market and new skills and competencies;<sup>49</sup> it is implemented in this clinic since 2019. This radical innovation strained the existing governance model, creating a disbalance between exploration and exploitation, leading to the perception of employees that managers used laissez-fair leadership for the regular operations due to a shift in their focus towards protons, thus resulting in a perceived lack of leadership by its employees. In addition, a division between proton and photon therapy was developed, hindering communication and information flow, resulting in coordination issues, not only between groups but also between governance layers. Finally, management complained about their SoC due to the new challenges.

Considering the above, the objective of this study is to explore whether a change in the organizational structure, with respect to the design principles SoC, unit grouping, and lateral linkages, within an organization can impact the perceived leadership style in the direction that is required for ambidexterity.

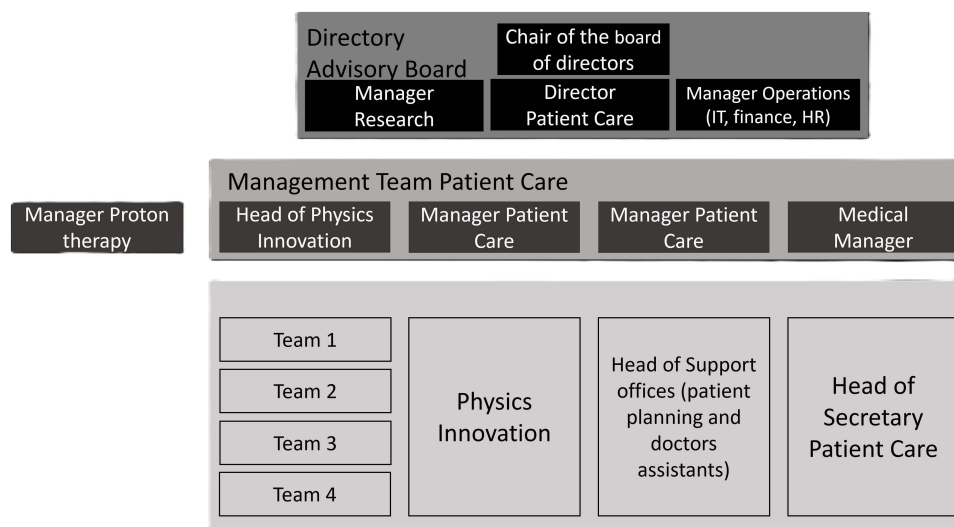
## Materials and Methods

### Study Design

Quantitative data on perceived leadership was gathered using validated questionnaires prior to and after implementation of changes in organizational structure in a large academic RTc as described above.

### Intervention

At the start of proton therapy implementation in 2019, employees in patient care (PC) were supervised by the Management Team Patient Care (MT-PC), which consisted of head of physics innovation, a medical manager, and 2 managers PC. The patient planning, doctors' assistants and secretary of patient care, as well as all personnel in training (physicians, physicists, and RTTs) had their own supervisors, which were in turn supervised by the MT-PC. The MT-PC was mainly supervised by the Director-PC and the chair of the Directory Advisory Board (DAB) (Figure 1). Integration of protons (exploration) and photons (exploitation) was organized in these two functions.



**Figure 1** Organizational structure of patient care before changes in structure.

When noticing the tensions described above, three interventions in the organizational structure were implemented in the first half of 2022. In line with the theory of Galbraith<sup>50</sup> the units of the organization involved in innovative practices were intentionally separated or “decoupled” from the regular organizational structure to better facilitate their development. At the same time information processing and transfer was facilitated between proton and photon therapy by adding a liaison function at the management level.

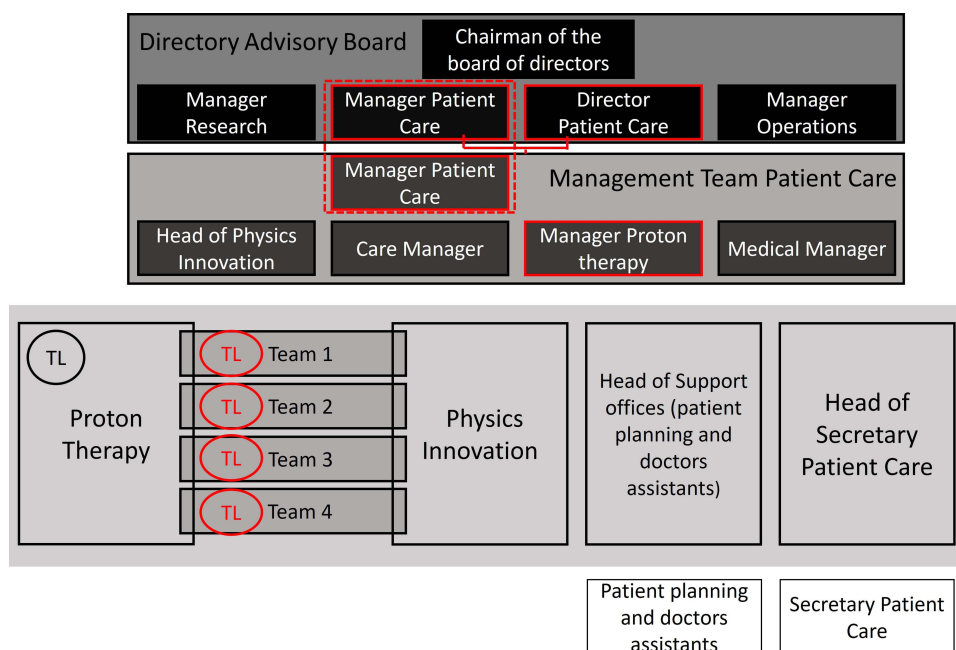
Intervention 1 was to introduce a team leader (TL) for each clinical team in the regular operations photon therapy, which consisted of radiation oncologists and radiotherapy technicians (RTTs), and were centered around 2–3 specific tumor types, enabling unit grouping and specialization. TLs were selected based on clinical expertise, experience, and their ability to manage cross-functional teams. Leadership training, including a program focused on communication and decision-making, and a year long coaching trajectory prepared and guided TLs for their new role. The newly introduced TLs also actively participate in the work tasks alongside the team, in contrast to the TL already in place in proton therapy, which was not actively participating in the work alongside the team because the TL proton therapy had to do many new projects for the startup of proton therapy. The proton therapy group did get a TL who actively participates in the work tasks alongside the team *after the T2 measurement*. Implementing dedicated leadership in the clinical teams in photon therapy aimed to improve the information flow, and the SoC of the MT-PC and thereby perceived leadership, whilst maintaining the dedicated leadership for protons in the form of a manager proton therapy supported by a TL proton therapy.

Intervention 2 was to adjust the managers PC: where first the 2 managers PC were not participating in the DAB, this was adjusted such that one manager PC was included in the DAB alongside the Director-PC, which aimed to improve lateral linkages in the form of better communication and vertical information flow between the management board and management of patient care.

Intervention 3 consisted of integrating proton and photon therapy at the tactical level by adding the manager proton therapy, as a liaison, to the MT-PC, to improve lateral linkages and unit grouping (Figure 2).

## Endpoints

Perceived leadership was measured using the validated Multifactor Leadership Questionnaire (MLQ),<sup>51,52</sup> a widely validated instrument with an established factor structure, to assess perceived leadership styles. The validity and reliability of the MLQ have been confirmed in several meta-analyses such as the study by Judge et al (2004) and Lowe et al (1996).<sup>53,54</sup> The MLQ (Multifactor Leadership Questionnaire) assesses three leadership styles with the following reported Cronbach’s alpha values: for the transformational Leadership subscale, alpha values typically range from 0.83



**Figure 2** Organizational structure of patient care after changes in structure. The TL for proton therapy was added after the T2 measurement.

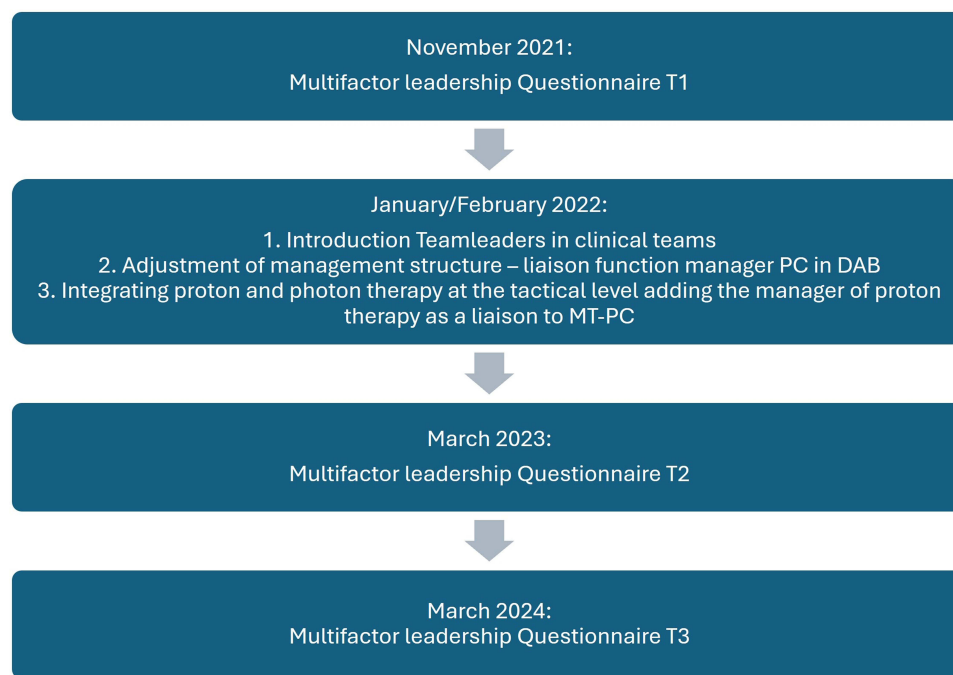
to 0.94, indicating high reliability. For the transactional Leadership subscale, alpha values generally range from 0.70 to 0.88, reflecting acceptable reliability. In contrast, for the passive-avoidant leadership subscale, alpha values tend to range between 0.60 to 0.80, suggesting lower internal consistency for this subscale.<sup>26,55–57</sup> Given the MLQ’s robust psychometric properties and extensive use in leadership research, we did not conduct additional factor analysis in this study. Our objective was not to develop or validate a new measurement tool, but rather to assess changes in leadership perceptions over time.

The questionnaire consists of two forms: a leader form and a rater form, both containing the same set of statements. The leader form is completed by managers, with statements formulated in the first person (“I”), to describe their own perceived leadership style. The rater form is completed by employees, with statements framed in the “my manager” format, to assess the leadership style of their manager from their perspective. The MLQ is a multi-rater (or 360-degree feedback) instrument and consists of nine scales: five for measuring transformational, three for transactional, and one for laissez-faire leadership styles, along with three scales for capturing leadership outcomes.<sup>26</sup> For all questions, a response scale ranging from 0 to 4 has been utilized (0=Not at all, 1=Once in a while, 2=Sometimes, 3=Fairly often, 4=Frequently, if not always). This questionnaire was chosen because it is the most used and validated questionnaire to measure experienced leadership.<sup>58,59</sup>

The questionnaire was distributed at three different time points: Prior to (T1), 1 year (T1) and 2 years (T2) after the organizational changes. **Figure 3** represents a flow chart of the study. The MLQ was spread out as a digital survey amongst all employees working in PC. In addition, managers were asked to fill out this questionnaire as a self-evaluation.

To achieve the highest possible response rate various engagement strategies were used, such as, sending personalized invitations for participation, ensuring confidentiality, and sending (personalized) reminders only to those who did not participate yet to complete the survey. The survey was only offered as an online survey, which allowed for efficient management and anonymity.

Furthermore, we recorded the function of respondents (eg radiation oncologist, RTT, physicist) to compare them with those of the entire organization, to check the representativity of the respondents.



**Figure 3** Workflow of the study.

## Study Population

Participants were selected based on their roles within the radiotherapy center, ensuring a representative sample across different organizational levels. All employees with contracts at the radiotherapy center were invited to participate in the study. In [Table 1](#) there is an overview of all departments included in this study.

## Data Analysis

The data of the MLQ was analyzed following the MLQ manual,<sup>51,52</sup> by grouping the MLQ items per leadership style and calculating averages, overall for PC, and separately for MT-PC and TLs. The Independent-Samples Mann–Whitney *U*-Test was performed to compare T1 and T2, T2 and T3, and T1 and T3, and to compare managers' self-rate scores and the scores given by employees at T1, T2 and T3, and to compare scores between employees working in photon treatment with employees in proton treatment, using IBM SPSS for Windows version 29.<sup>60</sup> For all tests, the significance level was set at  $p < 0.05$ . Respondents were tracked anonymously using unique, confidential codes to ensure consistency across the three time points. To assess whether the sample of respondents was representative of the overall population of the organization we gathered the actual number of employees per function and the number respondents per function. The actual proportion was calculated. Also, the proportion of respondents, the standard error (SE) and the 95% confidence interval (CI) were calculated.

## Results

### Sample Characteristics

At T1, T2 and T3 we invited 227, 228 and 246 employees of PC respectively, to participate in the MLQ survey, with response rates of 45%, 36% and 34% respectively. [Table 1](#) shows the respondents per department. The results of this analysis indicated that the sample reasonably reflects the organization's population on function characteristics. All leaders (7 at T1, 15 at T2 and 11 at T3) were invited to participate in the survey. Response rates were 100%, 73% and 82% respectively.

**Table 1** Respondents per Department with the Actual Number of Employees, Actual Proportion, Respondents' Proportion, Standard Error (SE) and 95% Confidence Interval (CI)

| T1   |                            |                   |                  |                        |       |              |   |
|--|----------------------------|-------------------|------------------|------------------------|-------|--------------|---|
| Department                                   | Actual Number of Employees | Actual Proportion | Respondents      | Respondents Proportion | SE    | 95% CI       | Included in the Analysis of PC, MT-PC and/or TL |
| Physician in training to become a specialist | 6                          | 0.026             | 1                | 0.010                  | 0.007 | -0.005-0.024 | PC  |
| Doctor's assistant                           | 17                         | 0.075             | 4                | 0.039                  | 0.014 | 0.011-0.067  | PC  |
| Physics Innovation & TiQC                    | 28                         | 0.123             | 17               | 0.165                  | 0.028 | 0.111-0.219  | PC and MT-PC                                    |
| Social work                                  | 3                          | 0.013             | 0                | NA                     | NA    | NA           | PC and MT-PC                                    |
| Mouldroom RTT                                | 2                          | 0.009             | 0                | NA                     | NA    | NA           | PC and MT-PC                                    |
| Patient planning                             | 21                         | 0.093             | 7                | 0.068                  | 0.019 | 0.031 -0.105 |   |
| RTT's  | 107                        | 0.471             | 52               | 0.505                  | 0.037 | 0.432-0.577  | PC and MT-PC                                    |
| Radiation Oncologists & Physician Assistants | 29                         | 0.128             | 16               | 0.155                  | 0.027 | 0.103-0.208  | PC and MT-PC                                    |
| Secretary's office Patient Care              | 6                          | 0.026             | 3                | 0.029                  | 0.012 | 0.005-0.054  | PC  |
| Staff Patient Care                           | 5                          | 0.022             | 1                | 0.010                  | 0.007 | -0.005-0.024 | PC and MT-PC                                    |
| Clinical Physicist in training               | 3                          | 0.013             | 3                | 0.029                  | 0.012 | 0.005-0.054  | PC  |
| <b>Total</b>                                 | <b>227</b>                 |                   | <b>103 (45%)</b> |                        |       |              |   |
| T2   |                            |                   |                  |                        |       |              |   |
| Discipline                                   | Actual number of employees | Actual Proportion | Respondents      | Respondents Proportion | SE    | 95% CI       | Included in the analysis of PC, MT-PC and/or TL |
| Physician in training to become a specialist | 7                          | 0.031             | 1                | 0.012                  | 0.009 | -0.005-0.029 | PC  |
| Doctor's assistant                           | 17                         | 0.075             | 3                | 0.035                  | 0.015 | 0.006-0.065  | PC  |
| Physics Innovation & TiQC                    | 28                         | 0.123             | 14               | 0.165                  | 0.030 | 0.106-0.223  | PC and MT-PC                                    |
| Social work                                  | 3                          | 0.013             | 1                | 0.012                  | 0.009 | -0.005-0.029 |   |
| Mouldroom RTT                                | 1                          | 0.004             | 1                | 0.012                  | 0.017 | -0.005-0.029 | PC and TL                                       |
| Patient planning                             | 23                         | 0.101             | 4                | 0.048                  | 0.034 | 0.014-0.081  | PC  |
| RTT's  | 104                        | 0.456             | 37               | 0.435                  | 0.079 | 0.357-0.514  | PC and TL                                       |

(Continued)

**Table 1** (Continued).

| Radiation Oncologists & Physician Assistants | 32                                | 0.140                    | 17                 | 0.200                         | 0.063     | 0.137–0.263   | PC and MT-PC   |
|--|-----------------------------------|--------------------------|--------------------|-------------------------------|-----------|---------------|--|
| Secretary's office Patient Care              | 5                                 | 0.022                    | 2                  | 0.024                         | 0.024     | 0.000–0.048   | PC   |
| Staff Patient Care                           | 5                                 | 0.022                    | 4                  | 0.047                         | 0.034     | 0.014–0.081   | PC and MT-PC   |
| Clinical Physicist in training               | 3                                 | 0.013                    | 1                  | 0.012                         | 0.017     | –0.005–0.029  | PC   |
| <b>Total</b>                                 | <b>228</b>                        |                          | <b>85 (37%)</b>    |                               |           |               |  |
| <b>T3</b>                                    |                                   |                          |                    |                               |           |               |  |
| <b>Discipline</b>                            | <b>Actual number of employees</b> | <b>Actual Proportion</b> | <b>Respondents</b> | <b>Respondents Proportion</b> | <b>SE</b> | <b>95% CI</b> | <b>Included in the analysis of PC, MT-PC and/or TL</b> |
| Physician in training to become a specialist | 8                                 | 0.033                    | 1                  | 0.012                         | 0.009     | –0.005–0.029  | PC   |
| Doctor's assistant                           | 20                                | 0.081                    | 9                  | 0.108                         | 0.025     | 0.059–0.158   | PC   |
| Physics Innovation & TiQC                    | 26                                | 0.106                    | 7                  | 0.084                         | 0.022     | 0.040–0.128   | PC and MT-PC   |
| Social work                                  | 3                                 | 0.012                    | 1                  | 0.012                         | 0.009     | –0.005–0.029  | PC and MT-PC   |
| Mouldroom RTT                                | 1                                 | 0.004                    | 0                  | NA                            | NA        | NA            | PC and TL  |
| Patient planning                             | 23                                | 0.093                    | 12                 | 0.145                         | 0.028     | 0.089–0.200   | PC   |
| RTT's  | 110                               | 0.440                    | 30                 | 0.361                         | 0.039     | 0.285–0.44    | PC and TL  |
| Radiation Oncologists & Physician Assistants | 33                                | 0.134                    | 15                 | 0.181                         | 0.031     | 0.120–0.242   | PC and MT-PC   |
| Secretary's office Patient Care              | 7                                 | 0.028                    | 3                  | 0.036                         | 0.015     | 0.007–0.066   | PC   |
| Staff Patient Care                           | 4                                 | 0.016                    | 4                  | 0.048                         | 0.017     | 0.014–0.082   | PC and MT-PC   |
| Clinical Physicist in training               | 5                                 | 0.020                    | 0                  | NA                            | NA        | NA            | PC   |
| Proton Physics                               | 6                                 | 0.024                    | 1                  | 0.012                         | 0.009     | –0.005–0.029  | PC and MT-PC   |
| <b>Total</b>                                 | <b>246</b>                        |                          | <b>83 (34%)</b>    |                               |           |               |  |

**Abbreviations:** TiQC, Technological innovation and Quality Control; RTT, radiotherapy technician; SE, standard error; CI, confidence interval; NA, not applicable; PC, patient care; MT-PC, management patient care; TL, team leader.

## Perceived Leadership in Patient Care (PC)

### PC Employees Perceived Leadership Scores Compared Over Time (T1 vs T2 vs T3)

The MLQ results for PC showed a significant increase in perceived transformational leadership over time, with participants' perceptions rising from an average score of **2.3** at both T1 and T2, to **2.5** by T3 (Figure 4). In contrast, perceptions of transactional leadership showed a slight decline over the same period. Figure 4 visualizes this decrease. Furthermore, perceived passive avoidant leadership significantly decreased over time (Table 2, Figure 4).



Figure 4 MLQ results in PC (\*P<0.05).

### PC Manager Self Evaluation Scores Compared Over Time (T1 vs T2 vs T3)

The scores on the MLQ, as completed by PC leaders, showed some fluctuations over time, but these variations were not statistically significant (Table 2, Figure 4).

### PC Employees Vs PC Manager Scores

A comparison between employee scores and PC leader self-evaluations on the MLQ revealed important discrepancies in perceived leadership styles. Notably, PC leaders consistently rated their transformational leadership significantly higher than employees did, across all time points in the study. For transactional leadership, significant differences were found at T1 and T2, where leaders rated themselves higher than employees. However, by T3, these differences diminished, indicating a potential convergence in perceptions over time. In contrast, there were no significant differences in passive-avoidant leadership at any time point (Table 2).

### Perceived Leadership of Management Patient Care (MT PC)

#### MT PC Employees Perceived Leadership Scores Compared Over Time (T1 vs T2 vs T3)

The MLQ results for MT-PC showed a steady significant increase in perceived transformational leadership over time. Starting at an average of 1.8 at T1, perceptions of transformational leadership rose significantly to 2.3 at T2 and further

Table 2 Mann Whitney U-Test Results Comparing T1 vs T2 vs T3 and Employees vs Managers in PC

|                                 | Transformational Leadership |               |               | Transactional Leadership |               |               | Passive Avoidant Leadership |               |               |
|---------------------------------|-----------------------------|---------------|---------------|--------------------------|---------------|---------------|-----------------------------|---------------|---------------|
|                                 | U-value T1-T2               | U-value T2-T3 | U-value T1-T3 | U-value T1-T2            | U-value T2-T3 | U-value T1-T3 | U-value T1-T2               | U-value T2-T3 | U-value T1-T3 |
| Employees working in PC         | 3433.5                      | 14,174.5*     | 5637.0**      | 3022.5                   | 13,031.0      | 4678.5        | 2673.5*                     | 9153.0*       | 2339.5**      |
| PC leaders' self-evaluation     | 29.5                        | 48.5          | 32.0          | 15.0                     | 39.0          | 18.5          | 29.5                        | 42.0          | 33.5          |
|                                 | U-value T1                  | U-value T2    | U-value T3    | U-value T1               | U-value T2    | U-value T3    | U-value T1                  | U-value T2    | U-value T3    |
| P-value Employees vs PC leaders | 491.5*                      | 230.0*        | 217.5*        | 439.5*                   | 190.5*        | 286.5         | 153.5                       | 411.5         | 306.5         |

Note: \*\*P<0.001; \*P<0.05.

Abbreviation: PC: patient care.

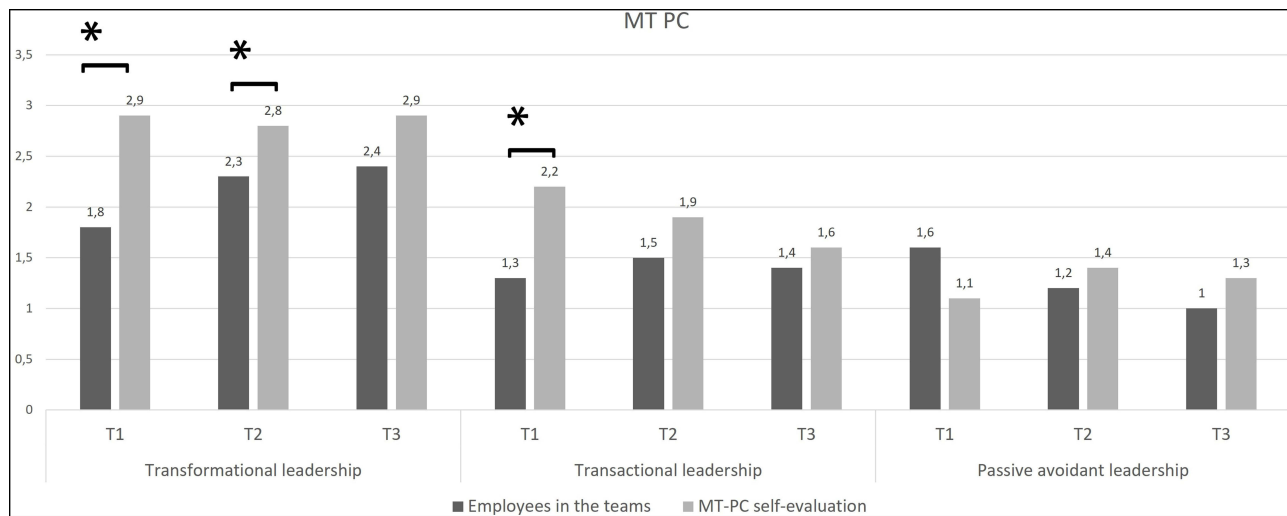


Figure 5 MLQ results for MT-PC (\*P<0.05).

increased to 2.4 at T3 (Figure 5). In contrast, there were no significant changes in transactional leadership, as the scores remained relatively stable across time (Figure 5). Meanwhile, perceived passive avoidant leadership showed a significant and steady decline. At T1, passive avoidant leadership was rated 1.6, but by T3, this score had dropped to 1.0 (Figure 5, Table 3).

### MT-PC Manager Self-Evaluation Scores Compared Over Time (T1 vs T2 vs T3)

The self-evaluation of MT-PC showed no statistically significant changes over time as indicated in Table 3. Transformational leadership, as rated by the leaders themselves, remained largely unchanged, showing no notable variation throughout the study period. Similarly, there was a slight decrease in transactional leadership, while passive-avoidant leadership saw a modest increase (Figure 5).

### MT-PC Employees Vs MT-PC Manager Scores

A comparison between employee scores and the self-evaluations of MT-PC leaders showed significant differences in perceived leadership styles. At T1 and T2, leaders consistently rated themselves significantly higher in both

Table 3 Mann-Whitney U-Test Results Comparing T1 vs T2 vs T3 and Employees Vs Managers in MT-PC

|                            | Transformational Leadership |               |               | Transactional Leadership |               |               | Passive Avoidant Leadership |               |               |
|----------------------------|-----------------------------|---------------|---------------|--------------------------|---------------|---------------|-----------------------------|---------------|---------------|
| MT-PC                      |                             |               |               |                          |               |               |                             |               |               |
|                            | U-value T1-T2               | U-value T2-T3 | U-value T1-T3 | U-value T1-T2            | U-value T2-T3 | U-value T1-T3 | U-value T1-T2               | U-value T2-T3 | U-value T1-T3 |
| Employees in the teams     | 1403.5*                     | 2011.5*       | 1503.5**      | 141.5                    | 1560.0        | 1189.0        | 1129.5                      | 1036.5*       | 649.5*        |
| MT-PC self-evaluation      | 4.0                         | 0.0           | 4.0           | 5.0                      | 1.5           | 0.0           | 7.5                         | 8.0           | 5.0           |
|                            | U-value T1                  | U-value T2    | U-value T3    | U-value T1               | U-value T2    | U-value T3    | U-value T1                  | U-value T2    | U-value T3    |
| P-value Employees vs MT-PC | 237.5*                      | 24.0*         | 7.5           | 232.0*                   | 34.5          | 20.5          | 72.0                        | 70.5          | 15.5          |

Note: \*\*P<0.001; \*P<0.05.

Abbreviation: MT-PC, management patient care.

transformational and transactional leadership compared to how their employees perceived them (Table 3). By T3, these differences had diminished, with no significant gaps between leaders' self-assessments and employee ratings for transformational or transactional leadership. For passive avoidant leadership, no significant differences were found overall. At T1, employees rated their managers higher in passive-avoidant behaviors, suggesting they perceived more avoidance or disengagement from leadership. By T2 and T3, this reversed, with leaders rating themselves higher in passive-avoidant leadership than their employees did.

## Perceived Leadership of Team Leaders (TL)

### RTTs Perceived Leadership Scores Compared Over Time (T1 vs T2 vs T3)

The MLQ results for RTTs, who underwent the biggest change, showed significant changes in their perceptions of leadership. Transformational leadership showed a substantial and steady increase, rising from 1.5 at T1 to 2.2 at T2, and reaching 2.4 by T3. A similar trend was observed for transactional leadership, which began at a relatively low score of 1.0 at T1, increasing to 1.4 at T2 and further to 1.6 at T3. Conversely, passive-avoidant leadership saw a sharp decline over time, dropping from 1.7 at T1 to 0.8 at T2, and further decreasing to 0.5 at T3 (Figure 6).

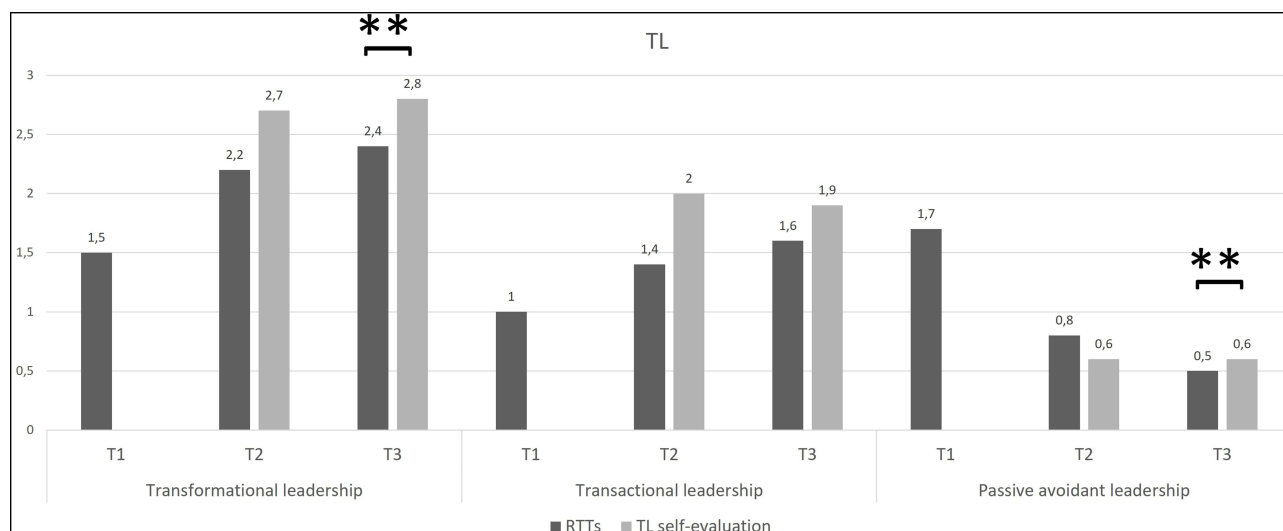
The comparisons between T1 and T3 showed significant increases in both transformational and transactional leadership ( $p < 0.001$ ) and a significant decrease in passive avoidant leadership ( $p < 0.001$ ). No significant changes occurred between T2 and T3 (Table 4). Note: at T1 there was no TL in place. The scores at T1 represent the RTTs' perceptions of leadership under MT-PC leaders, with the data reflecting only the RTTs' perspectives.

### TL Self Evaluation Scores Compared Over Time (T2 vs T3)

The TL self-evaluations showed relatively stable leadership perceptions over time, with only slight adjustments in their leadership styles. Transformational leadership, as rated by the TLs themselves, showed a modest increase, rising from 2.7 at T2 to 2.8 at T3. In contrast, transactional leadership experienced a small decline, with TLs rating themselves at 2.0 at T2 and 1.9 at T3. Meanwhile, passive-avoidant leadership remained unchanged, with TLs maintaining a low score of 0.6 at both T2 and T3.

## RTTs VS TL Scores

At both T2 and T3, there were no significant differences between the leadership ratings provided by employees and those given by managers themselves (Figure 6, Table 4).



**Figure 6** MLQ results for TLs (except for T1, this is the perceived leadership ship of RTTs under MT PC) (\*\* $P \leq 0.001$ ).

**Table 4** Mann Whitney U-Test Results Comparing T1 vs T2 vs T3 and Employees vs Managers Amongst RTTs

|                    | Transformational Leadership |               |               | Transactional Leadership |               |               | Passive Avoidant Leadership |               |               |
|--------------------|-----------------------------|---------------|---------------|--------------------------|---------------|---------------|-----------------------------|---------------|---------------|
| RTTs               |                             |               |               |                          |               |               |                             |               |               |
|                    | U-value T1-T2               | U-value T2-T3 | U-value T1-T3 | U-value T1-T2            | U-value T2-T3 | U-value T1-T3 | U-value T1-T2               | U-value T2-T3 | U-value T1-T3 |
| RTTs               | 858.5**                     | 485.0         | 1079.0**      | 712.5*                   | 530.0         | 989.0**       | 286.0**                     | 485.0         | 177.5**       |
| TL self-evaluation | X                           | 10.0          | x             | x                        | 4.0           | x             | x                           | 6.5           | x             |
|                    | U-value T1                  | U-value T2    | U-value T3    | U-value T1               | U-value T2    | U-value T3    | U-value T1                  | U-value T2    | U-value T3    |
| P-value RTTs vs TL | X                           | 63.5          | 406.0**       | x                        | 46.5          | 29.0          | x                           | 46.0          | 84.0**        |

Note: \*\*P≤0.001; \*P≤0.05.

Abbreviations: RTT, radiotherapy technician; TL, team leader.

## Perceived Leadership RTTs Working in Photons Vs Protons Over Time (T1 vs T2 vs T3)

Comparing photon and proton RTTs, showed no significant differences at both T1 and T3. However, at T2, photon RTTs rated transformational leadership significantly higher and passive-avoidant leadership significantly lower compared to proton RTTs (Table 5, Figure 7).

For photon RTTs, transformational and transactional leadership significantly increased between T1 and T2, while passive avoidant leadership significantly decreased. These trends persisted through T3, with no significant changes between T2 and T3. On the other hand, proton RTTs perceptions of transformational leadership significantly increased between T2 and T3, and passive avoidant leadership significantly decreased. When comparing T1 and T3, significant increases were observed in transformational and transactional leadership, alongside a decline in passive avoidant leadership.

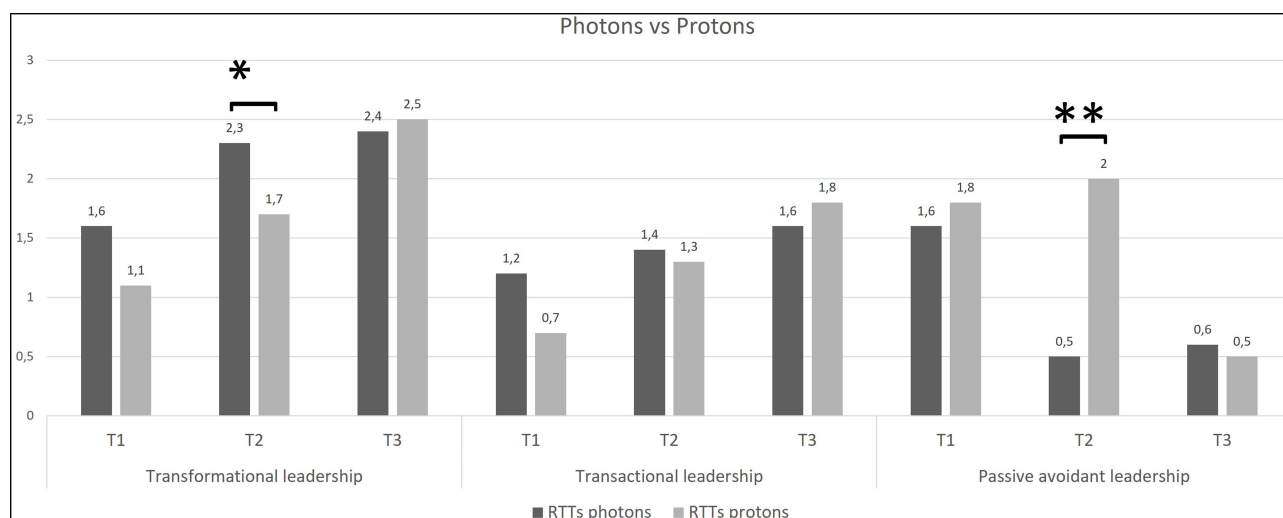
Overall, photon RTTs experienced earlier leadership improvements, while proton RTTs showed a delayed but more pronounced shift by T3. All results are included in Figure 7 and Table 5.

**Table 5** Mann Whitney U-Test Results Comparing T1 vs T2 vs T3 and Photon vs Proton RTTs

|                            | Transformational Leadership |               |               | Transactional Leadership |               |               | Passive Avoidant Leadership |               |               |
|----------------------------|-----------------------------|---------------|---------------|--------------------------|---------------|---------------|-----------------------------|---------------|---------------|
| RTTs Photons vs Protons    |                             |               |               |                          |               |               |                             |               |               |
|                            | U-value T1-T2               | U-value T2-T3 | U-value T1-T3 | U-value T1-T2            | U-value T2-T3 | U-value T1-T3 | U-value T1-T2               | U-value T2-T3 | U-value T1-T3 |
| RTTs photons               | 814.5**                     | 237.0         | 685.5**       | 693.0*                   | 277.5         | 594.5*        | 129.5**                     | 366.5         | 125.0**       |
| RTTs protons               | 37.5                        | 44.0*         | 45.0*         | 57.0*                    | 43.5*         | 47.0*         | 47.5                        | 2.5*          | 4.0*          |
|                            | U-value T1                  | U-value T2    | U-value T3    | U-value T1               | U-value T2    | U-value T3    | U-value T1                  | U-value T2    | U-value T3    |
| P-value photons vs protons | 147.8                       | 37.5*         | 76.5          | 121.5                    | 74.5          | 83.0          | 139.0                       | 196.0**       | 58.5          |

Note: \*\*P≤0.001; \*P≤0.05.

Abbreviations: RTT, radiotherapy technician; PC, patient care; MT-PC, management patient care; RTT, radiotherapy technician; TL, team leader.



**Figure 7** MLQ results for Proton vs Photon RTTs (\*\* $P \leq 0.001$ ; \* $P \leq 0.05$ ).

## Discussion

The findings of this study provide valuable insights into the impact of organizational structure changes on perceived leadership styles within an ambidextrous RT center. We found that structural changes in the organization can indeed have a significant impact on leadership perceptions, particularly in terms of increasing transformational leadership and decreasing passive avoidant leadership.

### The Impact of Changes in Organizational Structure on Perceived Leadership

The interventions introduced in this study to adjust the organizational structure, more specifically the introduction of TL in the clinical teams (leading to a smaller SoC), redefining management roles in MT-PC (linking MT-PC and DAB) and integrating proton and photon therapy teams at the tactical level (lateral linkages and unit grouping), have led to shifts in perceived leadership. Our findings suggest that structural interventions, particularly the reduction of SoC through the introduction of team leaders, and the strengthening of vertical and lateral linkages, may have contributed to improvements in specific dimensions of transformational leadership. By implementing these changes, leaders were better equipped to redefine and adapt their roles, enabling them to align more effectively with the organization's objectives. This approach fostered a more responsive and cohesive leadership structure, which in turn could lead to enhancing overall organizational performance.<sup>61</sup> Looking more closely at the reduction in SoC, with approximately 100 fewer RTTs under the direct supervision of MT-PC, more time and attention could be dedicated to the remaining group, likely contributing to the improved leadership perceptions. This is consistent with previous studies showing that leadership quality is often compromised when SoC is too broad.<sup>38,44</sup> Smaller SoCs have been associated with improved performance and leadership outcomes.<sup>62</sup> This closer alignment between leadership itself (MT-PC and DAB as well as proton and photon therapy managers at tactical level) and between management and employees contributed to the overall positive shift in leadership perceptions. Previous research showed that the SoC significantly influences how leadership is perceived within an organization.<sup>63</sup> Our results thus confirm that one must be cautious with downsizing the management layer to cut costs, as it can negatively impact satisfaction with perceived leadership, with all the associated consequences. While some interventions have been effective, others reveal deeper issues that require attention. Not only do structural changes affect perceived leadership, but also other internal and external factors such as experience, personality traits, education, training, motivation, organizational culture, team dynamics, and environmental challenges. Successful leadership requires a mix of these elements to align with organizational goals and foster collaboration and innovation.<sup>64</sup>

## Differences in Employee Scores and Manager Self-Evaluation Scores

Our results showed significant differences between the score of employees and managers' self-evaluation. Over time, these differences grew smaller to not significant. This suggests an increasing alignment in perceptions of leadership effectiveness. However, it is important to consider that the initial measurement may have influenced subsequent self-evaluations by leaders. Exposure to initial feedback can heighten leaders' self-awareness, prompting adjustments in their self-assessment to match employees' perspectives more closely. This phenomenon, also known as the "Hawthorne effect", suggests that individuals may alter their behavior when they are aware that they are being observed. In this context of leadership assessments, leaders might have consciously or unconsciously adjusted their responses based on their awareness of the results of T1 or their desire to present a particular image.<sup>65,66</sup> This phenomenon is supported by research indicating that self-assessment and reflection can lead to more effective leadership behaviors and improved relationships with team members.<sup>67</sup>

## Differences in Perceived Leadership Between Proton RTTs and Photon RTTs

Significant differences were observed between RTTs in photon and proton therapy units. Photon RTTs reported more noticeable improvements in perceived transformational leadership than their counterparts in proton therapy. This divergence can be attributed to the distinct roles and challenges each team faces. Photon teams benefited from leaders actively participating in day-to-day tasks, which may foster closer relationships and better communication.<sup>68</sup> In the proton team such a TL was only introduced after T2 measurement. At T3 scores between proton and photon RTTs were similar.

## Contributions, Strengths and Limitations

This study contributes to the academic discourse on leadership and organizational design by empirically examining how structural changes influence perceived leadership in a complex, ambidextrous healthcare environment. While leadership is often studied as a set of individual behaviors or traits, our findings demonstrate that structural conditions, such as reduced span of control and clarified managerial roles, also significantly affect how leadership is perceived. This supports the argument that leadership is not only a behavioral construct but is embedded within organizational systems. By doing so, this study adds to a growing body of research calling for a more integrated view of leadership and organizational context. Moreover, the longitudinal design allows for insight into how these perceptions evolve over time, providing an empirical basis for theory-building on the dynamic interaction between leadership and structural change. Specifically, it extends existing theories by showing that smaller SoC, role redefinition, and team integration positively influence perceptions of transformational leadership and reduce passive avoidant leadership, aligning leadership practices with organizational objectives.

One of the strengths of this study is that it contains a baseline measurement, performed pre-intervention implementation and it includes long term follow up with a first post intervention after a year (T2) with another follow up measurement a year later (T3). This long-term follow up allows us to assess the long-term effects of the implementation of the change in organizational structure on perceived leadership. We must consider, however, the bias that we might have incurred during this study. Our results show that the difference between employees' scores and the leaders' self-evaluation score grew closer over time. We must consider the "Hawthorne effect" influencing the self-evaluation scores of leaders. Furthermore, non-response bias must also be considered.<sup>69</sup>

While response rates were below 50%, this is consistent with trends observed in healthcare settings, where survey participation is often limited by clinical workload and time constraints.<sup>70</sup> Response rates varied across time points, while this may affect generalizability, the sample remained representative of the organization, supporting the reliability of the findings. However, inconsistent participation introduced variability, complicating direct comparisons and limiting individual-level analysis.<sup>70</sup> In this study we tried to limit non-response bias by sending personalized invitations for participation, ensuring confidentiality, and sending (personalized) reminders only to those who did not participate yet to complete the survey. The survey was only offered as an online survey, as we would not be able to guarantee confidentiality when using a paper version of the survey. Despite all efforts to secure a representative sample, the response rate was approximately 35%, which, although acceptable, may still reflect sample bias as those more engaged or with stronger opinions are more likely to participate.

Additionally, desired response bias, where respondents provide socially desirable answers, could influence both employee and leader evaluations, especially since leadership assessments are inherently subjective.

Furthermore, it is challenging to determine whether changes in leadership perceptions resulted from structural adjustments or shifts in leadership personnel. New leaders may bring their own styles and influence, which can bias the findings. Furthermore, both self-assessments by leaders and employee perceptions are inherently subjective, shaped by personal preferences, past experiences, and interpersonal dynamics.

While the longitudinal design is a strength, we acknowledge that potential confounding variables, such as staff turnover, departmental restructuring, changes in patient volume, and technological updates, may have influenced the observed outcomes. These factors were not controlled for, which we now explicitly discuss in the manuscript. We believe this approach allows the study to capture the complexities of the healthcare environment, thereby increasing ecological validity and offering insights into how such interventions function in practice.

## Theoretical and Practical Implications

These theoretical contributions are complemented by practical insights that can inform leadership practices in similar healthcare and ambidextrous settings. Implementing smaller spans of control, redefining management roles, and integrating teams at the tactical level helped improve leadership perceptions. These strategies may be valuable for organizations aiming to foster responsive leadership, enhance communication, and support interdisciplinary collaboration. Specifically, introducing team leaders who actively participate in daily work appears to strengthen leadership visibility and team cohesion. Healthcare organizations undergoing structural changes could adopt similar strategies to improve leadership alignment, job satisfaction, and overall organizational performance.

## Future Research

Future research could extend the findings by examining the long-term sustainability of these leadership interventions. Studies could track leadership perceptions and outcomes over an extended period or explore how leadership traits influence the success of such interventions. Additionally, comparative studies across different healthcare sectors and industries would help assess the generalizability of these leadership practices and further refine best practices for ambidextrous organizations.

## Conclusion

This study aimed to investigate the impact of organizational structure changes on perceived leadership styles within an ambidextrous healthcare organization. Our findings suggest that changes in the organizational design can indeed influence leadership perceptions in a manner conducive to ambidexterity. Specifically, across all groups, PC, MT-PC, and TL, there was a significant increase in perceived transformational leadership and a significant decrease in perceived passive avoidant leadership over time. Although changes in transactional leadership were less pronounced and mostly non-significant, the overall trend indicates a positive shift towards leadership styles that are more aligned with the requirements of ambidexterity.

These findings have practical implications for healthcare management. In the context of radiotherapy, for example, the shift towards more transformational leadership has likely enhanced team cohesion, improved communication, and supported the integration of proton therapy alongside photon therapy. This could lead to better patient care, as well as more efficient collaboration within multidisciplinary teams. However, while these results are promising, it is important to note that the study's reliance on self-reported data may introduce bias, and the specific cultural context of the Dutch healthcare system may limit the generalizability of the findings to other healthcare environments.

These insights have broader implications, suggesting that similar organizational changes could be applied in other healthcare sectors to enhance leadership effectiveness and support the development of adaptable, innovative practices. Nonetheless, further research is needed to replicate these findings in diverse settings and explore additional factors influencing leadership dynamics.

## Ethics Approval and Informed Consent

This study was conducted in compliance with the principles outlined in the Declaration of Helsinki and adhered to ethical guidelines for research involving human participants. Approval for the study was obtained from the Institutional Review Board (IRB) of Stichting Maastricht Radiation Oncology (Maastr) (approval number: W 21 09 00039), prior to the commencement of the research.

All participants were provided with detailed information about the study's purpose, procedures, potential risks, and benefits. Participation in the study was voluntary, by participating employees provided informed consent before any study-related activities were undertaken. Participants were assured of their right to withdraw from the study at any time without consequence. Confidentiality and anonymity of participants' data were strictly maintained throughout the study and in all dissemination of findings.

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## Disclosure

The authors report no conflicts of interest in this work.

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